Application No. 09/916,181
Reply to Office Action of October 7, 2003

Amendments to the Claims

The following listing of the claims will replace all prior versions, and listings of the claims in the application:

Listing of Claims

1. (Currently amended) A method for inspection of circuit boards comprising:

process of measuring surface-shape <u>data</u> of a circuit board on which inspection objects are placed;

approximated curved surface generation process for generating an approximated curved surface <u>from the measured surface-shape data</u>, which is an estimated surface-shape of the circuit board, on which no inspection object is placed, ~~from measured surface-shape data~~;

process of subtracting said approximated curved surface ~~generated~~ from the measured surface-shape data;

~~ROI~~ <u>region of interest</u> determination process of determining regions which are different from the approximated curved surface in accordance with ~~the~~ data obtained by said subtraction process; and

process of inspecting whether electronic parts placed on said circuit board and connecting materials for connecting <u>the</u> electronic parts are in a desired state or not.

2. (Previously presented) A method for inspection of circuit boards according to claim 1, wherein said approximated curved surface generation process comprises:

histogram generation process in which measured data of the surface-shape of the circuit board are divided into small regions and a histogram in the measured data of the surface-shape of the respective divided regions is generated,

circuit board height determination process for determining values of the circuit board heights at predetermined particular coordinate points in respective divided regions from the generated histogram, and

process in which the height values at other coordinate points than said coordinate

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points at which the circuit board height values were determined are determined by an interpolation process using already determined height values, and thereby an approximated curved surface of the circuit board is generated.

      3.   (Previously presented)   A method for inspection of circuit boards according to claim 2, wherein said histogram generating process comprises:

      process of measuring the reflected light amount from the circuit board,

      process of determining those regions that show a light amount of a particular intensity in measured reflected light amount data, and

      process of generating a histogram of the surface-shape data of particular regions using only those determined regions showing a particular intensity light amount.

      4.   (Previously presented)   A method for inspection of circuit boards according to claim 2, wherein said histogram generating process comprises:

      process of measuring the color information of the circuit board, and

      process of generating a histogram of the surface-shape data of particular regions using only those regions showing a particular color information in the measured color information.

      5.   (Currently amended) A method for inspection of circuit boards according to claim 2, wherein said histogram generating process comprises process of generating a histogram of the surface-shape data of particular regions using only those particular regions in a ~~CAD~~ <u>computer aided design</u> data of the circuit board.

      6.   (Previously presented)   A method for inspection of circuit boards according to claim 3, wherein said region determination process comprises:

      process of generating a histogram in the reflected light amount data,

      process of determining a threshold value by which the histogram regions are divided from the generated histogram,

      process of region-dividing the reflected light amount data by the determined threshold value, and

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process of determining the regions of a particular light amount data from among divided regions.

7.   (Previously presented)   A method for inspection of circuit boards according to claim 2, wherein said circuit board height determination process determines the maximum values of the histograms as the height values of the circuit board.

8.   (Previously presented)   A method for inspection of circuit boards according to claim 2, wherein said circuit board height determination process calculates approximated curves of the histograms and determines its maximum values as circuit board height values.

9.   (Previously presented)   A method for inspection of circuit boards according to claim 2, wherein, in process for getting the height values of the whole surface of the circuit board by said interpolation process, the whole surface of the circuit board is approximated by a curved surface by a higher-order interpolation process, and this is determined as an approximated curved surface of the circuit board.

10.   (Previously presented)   A method for inspection of circuit boards according to claim 1, wherein, in said approximated curved surface generating process, a curved surface as a new approximated curved surface is obtained by adding an offset value to the generated approximated curved surface, then the subtraction process is performed by using this approximated curved surface.

11.   (Currently amended) A method for inspection of circuit boards according to claim 1, wherein, in said ~~ROI~~ region of interest determination process, calculating ~~area~~ a real value of respective ~~ROI~~ region of interest obtained by said subtraction process, wherein only the ~~area~~ real value that is in a predetermined range are determined as the ~~ROI~~ region of interest

12.   (Currently amended) A method for inspection of circuit boards according

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to claim 1, wherein said ~~ROI~~ region of interest determination process comprises process of reduction and expansion, as well as eliminating minute regions with respect to respective ~~ROI~~ region of interest obtained by said subtraction process.

13.   (Currently amended)   A method for inspection of circuit boards according to claim 1, wherein ~~ROI~~ region of interest determination process comprises:

process for expanding the ~~ROI~~ region of interest, process of separating the expanded ~~ROI~~ region of interest to a ~~ROI~~ region of interest and a board surface region, and process of performing the inspection for the separated ~~ROI~~ region of interest.

14.   (Currently amended)   A method for inspection of circuit boards according to claim 1, wherein the ~~ROI~~ region of interest determined in said ~~ROI~~ region of interest determination process is made to be a teaching data which set an inspection reference.

15.   (Currently amended)   A circuit board inspection apparatus comprising:

a measuring section for measuring ~~data of a~~ surface-shape data of a circuit board on which inspection objects are placed;

an approximated curved surface generating section for generating an approximated curved surface which is estimating a surface-shape of the circuit board on which no inspection object is placed;

a subtraction section for subtracting the ~~generated~~ approximated curved surface from the measured surface-shape data;

an inspection objective-area determination section for determining regions which are different from the approximated curved surface as ~~ROI~~ regions of interest in accordance with ~~the~~ data obtained ~~in~~ by said ~~process~~ subtraction section; and

an inspection ~~sections~~ section for inspecting whether ~~said~~ electronic parts placed on the circuit board as well as connecting materials for connecting the electronic parts are in a desired state or not, with respect to the determined ~~ROI~~ regions of interest.

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16.   (Previously presented)   A circuit board inspection apparatus according to claim 15, wherein said approximated curved surface generation section compri ses:

a histogram generation processing section in which measured data of the surface-shape of the circuit board are divided into small regions and a histogram in the measured data of the surface-shape of the respective divided regions is generated,

a circuit board height determination section for determining the circuit board hei ghts at predetermined particular coordinate points in the respective divided regions from the generated histogram, and

a processing section in which the height values at other coordinate points than said coordinate points at which the circuit board height values were determined are determined by an interpolation process using already determined height values, and thereby an approximated curved surface of the circuit board is generated.

17.   (Previously presented)   A circuit board inspection apparatus according to claim 16, wherein said histogram generating processing section comprises; a processing section for measuring the reflected light amount from the circuit board,

a region determination processing section for determining those regions that show a light amount of a particular intensity in measured reflected light amount data, and

a processing section for generating a histogram of the surface-shape data of parti.ular regions using only those particular regions showing a particular intensity light amount.

18.   (Previously presented)   A circuit board inspection apparatus according to claim 16, wherein said histogram generating processing section comprises:

a processing section for measuring the reflected light amount from the circuit board, and

a processing section for generating a histogram of the surface-shape data of the particular regions using only those regions showing a particular color information in the measured color information.